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Geometrical product specifications (GPS) — Population specification

Spécification géométrique des produits (GPS) — Spécification de population

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

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Introduction

This International Standard is a Geometrical Product Specification (GPS) standard and is to be regarded as a global GPS standard (see ISO 14638). It influences all chain links of all chains of standards.

The ISO/GPS Masterplan given in ISO 14638 gives an overview of the ISO/GPS system of which this document is a part. The fundamental rules of ISO/GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated. For more detailed information on the relationship of this International standard to other standards and to the GPS matrix model, see Annex A.

In order to define the permissible interval for a geometrical characteristic, the designer only defines a condition (a unilateral tolerance limit or a bilateral pair of tolerance limits) for each workpiece, by considering the worst case impact in an assembly.

But when the tolerancing is based on a set of hypotheses about the population of the workpieces, one or more additional requirements should be added to verify these hypotheses.

NOTE The intent of this International Standard is not to define calculation methods to determine tolerances, but to give the means to express the hypotheses to verify.

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Geometrical product specifications (GPS) — Population specification

1 Scope

This International Standard defines rules to establish and to indicate population specifications, which are used to specify conditions on population characteristics, which are established from a set of characteristic values obtained one on each workpiece of a population of workpieces.

A population specification (as applied to a population of workpieces considered as a collection and not as individual items) can be seen as a complementary requirement to the individual specification (as applied to each workpiece considered as individual items). Population specifications express the statistical hypotheses used on the population of workpieces.

NOTE 1 A population specification is a complement to an individual GPS specification.

NOTE 2 This International Standard is not intended to mandate a given tolerancing method or how to calculate tolerance values. Its intent is to specify tools to allow the expression of population specifications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 14405-1, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO 17450-1, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17450-1 and the following apply.

3.1
population characteristic
statistic defined from the characteristic values, obtained on the population of workpieces or the population of assemblies

Note 1 to entry: Population characteristics are used to consider the population of workpieces.

Note 2 to entry: Population characteristics are only statistically meaningful when the values are based upon global individual characteristics, see Example 2.

EXAMPLE 1 The arithmetic mean and the standard deviation of a global individual characteristic on the population of workpieces, are population characteristics.

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EXAMPLE 2 The minimum circumscribed diameter has one unique value for a given cylindrical feature. Therefore a population characteristic based on this individual characteristic value will be statistically meaningful. The two-point diameter for a given cylindrical feature will vary within a range, dependent upon the form deviations of the feature. In this case, one population characteristic for two-point diameter cannot be defined from the population of values. However, it is possible to establish a population characteristic from the maximum two point diameter along the geometric feature, which is a global individual characteristic, together with a population characteristic from the minimum two-point diameter along the geometric feature which is another global individual characteristic.

3.2
population condition
limit that applies to the population characteristic value

Note 1 to entry: Population conditions can be used for statistical process control (SPC).

EXAMPLE The mean value, μ, of the minimum circumscribed diameter of a population of workpieces can be considered as a population characteristic, and required to be less than or equal to 10,1, which is a population condition (see Clause 6).

3.3
statistic
completely specified function of random variables

[SOURCE: ISO 3534-1:2006, definition 1.8, modified — Notes have not been reproduced.]

Note 1 to entry: In GPS, the random variables, which are used are in most of cases one-dimensional (scalar). Multi-dimensional (vector) variables also exist.

Note 2 to entry: For a population or a sample of individual characteristic values, at least one statistic can be applied. In GPS, a statistic can be used on a population of local individual characteristic values taken on one workpiece or, on a population of global individual characteristic values taken on a population of workpieces.

EXAMPLE See Table 1. More information can be found in ISO 3534- series.

Table 1 — Non exhaustive list of population statistics[a]

	Description of the statistic	Mathematical description according to ISO 3534-1[b]
A)	Minimum	minimum (X)
B)	Maximum	maximum (X)
C)	Mean: expected value	$\mu = E(X) = \frac{1}{n}\sum_{i=1}^{n} X_i$, or $\mu = E\left[g(X)\right] = \int g(X)\mathrm{d}p = \int g(x)\mathrm{d}F(x)$
D)	Mean deviation: difference between the mean and the target value (τ)	$\delta = \mu - \tau$
E)	Standard deviation	$\sigma = \sqrt{V(X)}$
F)	Variance	$V(X) = E\left\{\left[X - E(X)\right]^2\right\}$
G)	y % distribution quantile of the variable X	$X_{y\,\%}: P\left[x \le X_{y\,\%}\right] = y\ \%$

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